

## BOOK REVIEWS

### Suspecting terrane analysis

Dewey, J. F., Gass, I. G., Curry, G. B., Harris, N. B. W. and Şengör, A. M. C. (editors) 1991. *Allochthonous Terranes*. Cambridge University Press, Cambridge, U.K. 199 pp. Price £37.50, \$64.50 (hardback).

This volume resulted from a Royal Society Discussion Meeting in November 1989 convened "to assess the past, present and future significance of the terrane concept". The volume contains 12 papers by conference participants, selected discussions and replies following some papers, and a Preface and Concluding Remarks by J. F. Dewey. All of the contributions were previously published in the *Philosophical Transactions of the Royal Society*, as Volume 331, Number 1620.

The first paper, "Terranology: Vice or Virtue", by Şengör and Dewey, seems to have tried to set the tone for the conference serving as the 'pro' argument to some unstated 'proposition' such as "terrano-logy is a useless, and indeed dangerous, outmoded, and flawed exercise as a methodology of regional tectonic analysis and synthesis". The paper is articulate and forcibly argued in the style of classical debate. Unfortunately, no one was either given, or took, the opportunity to write the rebuttal. The second paper by D. L. Jones is a review and synopsis of his current thinking on terrane accretion in western North America. Only 6 pages long, with one figure and no references, the paper is more an expanded abstract, but characteristically includes some rigorous and cogent observations. E. Irving and P. J. Wynne discuss the status of older and more recent paleomagnetic data and its bearing on the tectonic evolution of the Canadian Cordillera. The paper is well written and illustrated and would provide readers with a fairly clear vision of the paleomagnetic data for the more 'mobilistic' interpretations of the Cordilleran 'collage'. The fourth paper, titled "On Terrane Analysis", by W. B. Hamilton, is actually two papers which are somewhat awkwardly combined into one contribution. The first 'part' is a vituperative critique of the terrane concept and those that practice it, with particular emphasis on the cluttering of the literature with myriad non-genetic terrane names and an unfortunately quite personalized implication that those scientists that use the terrane approach do so because they are somehow inadequate, lacking in understanding of plate tectonics. This, of course, is a rather serious charge, particularly when no specific citation is offered so that the accused and the scientific community at large can evaluate if the charge has substance. The paper then moves into a fresh analysis and interpretation of the Carpathian region, but unfortunately has no illustrations, thus is very difficult for the unfamiliar to follow. A paper by P. F. Hoffman, in my view one of the best in the volume, discusses the geologic and seismic tomographic evidence that the mostly Archean Precambrian shields, as opposed to Archean-Proterozoic cratons in general, are supported by an anomalous deep mantle root perhaps derived from special subduction processes typical of the Archean. The paper has fresh observations, ideas and insight, and will have implications for those thoughtful of geodynamics and the evolution of tectonic process through geologic time. The next paper, by N. B. W. Harris, I. G. Gass and C. J. Hawkesworth, applies isotopic and geochemical data to terrane distributions of the Pan African Afro-Arabian shield and argues the collage is an amalgamation of mainly late Precambrian intra-oceanic arcs and minor continental fragments which accreted against a continental margin in northeast Africa. This is 'chemotectonic' fingerprinting of terranes, also now being undertaken in other mountain belts, and is probably one of the more important areas of research now focused on the 'suspect' terranes. This is followed by a review of metamorphism in the western United States by W. G. Ernst, and then a paper by M. G. Audley-Charles and R. A. Harris which discusses allochthonous terranes in the Southwest Pacific and Indonesia. The next paper by Jin-Lu Lin and M. Fuller presents paleomagnetic data which they feel supports a Late Triassic-Early Jurassic collision of the North and South China blocks. An interesting paper on the Scottish Caledonides by B. J. Bluck uses various terrane linkage, or the lack of, arguments to conclude the region is a collage of truncated fragments caught along the destructive margin of Laurentia

as it closed with 'Pan Africa'. Next is a paper by Y. Yilmaz which states Turkey consists of a number of tectono-stratigraphic terranes (he calls them entities) which were successively accreted to Eurasia since the late Paleozoic. The final paper by I. Metcalfe, in my view the most useful paper in the volume, describes the terranes of Southeast Asia and their history of transfer across Tethys from Gondwanaland to Asia. Metcalfe's work is the first I have read that makes this complex region for me at last more comprehensible.

In summary, this volume has several very interesting and useful contributions, but is quite uneven. There are an unusual number of typographical errors and/or spelling mistakes. A number of the papers read like expanded abstracts of more complete work already, or to be published elsewhere and are not adequately illustrated. The discussions about the 'terrane concept' found for the most part in the first paper by Şengör and Dewey, in the contribution of Hamilton, and a sentence in Yilmaz's paper are discussions about methodology. Methodological discussions are always of interest, but the arguments that ensue are often emotional and in the end rarely have much to do with the way scientists behave in the field or laboratory, as recent research in the cognitive sciences has shown. In the end, we all seem to recognize the same objects, as most of the fine regional geologic papers in the volume amply show, and whether we call them terranes, entities, belts, micro-continents, intraoceanic magmatic arcs, etc., becomes a semantic rather than a scientific debate. The somewhat personalized tone of some of the methodological arguments in this book however, in my view, is unfortunate and mars the volume. The remarks mentioned above in Hamilton's paper, and also, for example, the last sentence in Dewey's "Concluding Remarks", would be expected and appropriate to a jolly good post-session evening at the pub around the corner from the Royal Society, but seem inappropriate to a scholarly scientific publication. But perhaps all this emotion is understandable, for the use of the term "Dewey-grams", for example, early on in the enthusiasm of some of the 'terrano-logists', which made me wince at the time, was also personalized and very unfortunate. John Dewey's papers and their illustrations, after all, were instrumental in helping us all conceptualize "The New Global Tectonics" and use it more effectively. But in the end it is the key issue surrounding the terrane concept from the beginning that was not addressed very much in the methodological contributions in this volume, but is very clear in most of the regional tectonic contributions, and that is the *uncertainty* in paleogeographic and paleotectonic settings of many large objects, entities, or terranes found in orogenic systems. This still plagues all of us 12 years later as we try to reconstruct the tectonic evolution of the world's mountain chains. No matter if you call the Coast Plutonic belt of western Canada a micro-continent, a continental margin arc, a metamorphic overprint, or the Tracy Arm terrane, you cannot, as we speak, fill a phone box with people who agree on exactly what it is or how it got outboard of three major oceanic terranes between it and the North American cratonic margin. Eventually the problems will be resolved, I predict, by good scientists doing good science whatever particular methodological flag they fly.

Peter J. Coney

Tucson, Arizona, U.S.A.

### Appalachians and Ouachitas: a single chain?

Hatcher, R. D. Jr, Thomas, W. A. and Viele, G. W. (editors) 1989. *The Appalachian-Ouachita Orogen in the United States*. Geological Society of America, Boulder, Colorado, U.S.A. 767 pp. + 12 plates in slipcase, (ISBN 0-8137-5209-4.) Price \$75.00.

The Appalachian-Ouachita belt is one of the best known mountain belts in the world—a region that has been studied for more than 150 years, and one that has provided the geologic framework for a number

of fundamental tectonic principles. Any attempt to summarize the geology of this entire region is a monumental task; to bring together different workers with diverse viewpoints and still produce a coherent volume is a huge editorial challenge. Happily the editors have been able to do both, presenting an overall balanced picture of the portion of this extensive mountain belt that lies in the United States, and allowing authors to present their diverse views so that readers can draw their own conclusions on conflicting interpretations.

The volume is divided into two parts, with the first 14 chapters (and plates 1–7, and 12) dealing with the Appalachians, and chapters 16–30 (and plates 8–11) devoted to the Ouachitas. Chapter 15 deals with subsurface information on the area where the two belts come together and clearly demonstrates them as being separate but overlapping (in space and time) belts. In spite of many similarities between the Appalachians and the Ouachitas and their traditional representation as part of a single chain (and therefore their inclusion in a single volume), what really stands out in reading the two parts of the volume are the enormous differences in lithology, stratigraphy and tectonic evolution between these two belts. Perhaps the two are part of a single chain in the sense that the Himalayas and the Zagros are part of a single chain.

The section on the Appalachians contains chapters on pre-orogenic terranes, the Taconic, the Acadian, and the Alleghanian orogens, post-Paleozoic tectonics, late Paleozoic thermal evolution, subsurface structure under the coastal plain, and shorter chapters on paleontological contributions, geophysical characteristics, geomorphology, mineral deposits and energy resources; the section ends with a tectonic synthesis. The authors of the chapters describing the orogens have tried very hard to cover all viewpoints and to leave interpretations and conclusions as open and subject to change as possible; this does result in enormously long texts, but is useful from the point of view of future research workers. The authors also point out the complexity and time-transgressive nature of the individual orogenic episodes and ask whether the traditional three-part orogenic history of the Appalachians should still be considered valid. Yet the volume does present the material in the framework of the traditional three-part history; on the one hand this makes it comfortable for most current Appalachian geologists, but on the other it makes it difficult for future workers to think about the Appalachians from new and different viewpoints. The chapter on pre-orogenic terranes presents considerable information on lithology and geochronology, but little or no information on Grenville or Avalonian deformation or tectonics; this leaves an enormous hole in the tectonic syntheses of the later orogens, not allowing the reader to see how the fabric and tectonics of the earlier orogens may have affected the tectonic development of the Appalachians. The final tectonic synthesis (Chapter 14) does pull together some of the other chapters, but depends too much on previously unpublished (other than Abstracts) material; it is presented as one possible tectonic scenario, and leaves the door open for other possible ones that the reader may want to think of.

The section on the Ouachita–Marathon belt has chapters on Paleozoic biostratigraphy, pre-orogenic stratigraphy and Carboniferous flysch deposits of the Ouachitas, pre-Permian rocks of the Marathons, Ouachita thrust belt, Benton–Broken Bow uplifts, subsurface Ouachitas under the coastal plain, Marathon fold–thrust belt, foreland structures, geophysical review and tectonic synthesis, with shorter chapters on mineral deposits and hydrocarbons. Once again the chapters are well written, attempting to present all viewpoints and leaving interpretations as open as possible. Like other orogens this one appears to have its own peculiar traditions: two that are quite obvious are the rather artificial subdivision of a single fold–thrust belt into longitudinal belts based on the stratigraphy exposed at the surface (with separate chapters devoted to each!), and the use of the term “uplift” to describe structures that are (from maps and cross-sections) clearly doubly-plunging culminations formed by stacking of imbricate thrust sheets. The geophysical review presents useful colored maps (plate 10) on gravity and aeromagnetic data; other maps and cross-sections (plates 8–11) effectively pull together the tectonic similarities between the Ouachita and Marathon belts, as does the tectonic synthesis chapter. The Epilogue provides a nice summary of problems that need to be addressed in the Ouachitas. One such problem is the ‘southward vergence’ of folds on the south side of the culminations—it is clear from the descriptions that workers in the area have not attempted to look at these folds as ones whose asymmetry has been reversed by large amounts of simple shear (as described from the Alps by Ramsay and his coworkers), even though other parts of the same thrust sheets contain sheath folds which obviously imply considerable shearing.

One of the nicest features of the volume are the 12 plates—maps and cross-sections—which summarize some of the latest data available on

the Appalachian–Ouachita belts. Conspicuous by their absence are gravity and aeromagnetic maps of the Appalachians, and additional seismic sections (particularly COCORP data)—although these have been published elsewhere before, their inclusion would have made the volume more complete. The individual chapters provide very comprehensive reference lists which should be very useful to readers wishing to pursue further any of the topics covered in the volume.

There is generally a time-lag in editing and producing a volume that involves so many authors: as a result the book tends to be a little out of date even when it first comes out because the latest material cannot be included. Keeping this in mind, a book like this, whose primary function is to pull together available data, can still be very useful if it is carefully edited. Unfortunately, in this volume there are lapses in technical editing that take away from an otherwise good book: there are more than a few spelling errors in the text and on figures, occasionally insufficient information in figure captions, and references to features on figures that are either inadequately highlighted or entirely missing.

In spite of these minor shortcomings the book does an excellent job of pulling together the information available, and should serve as a useful reference volume for years to come. It could also serve as a textbook for upper level courses on the Appalachian–Ouachita mountain belts; given the prices of most text-books, this book (for its price) merits serious consideration. For geologists working in the Appalachian or Ouachita–Marathon belts it is a book well worth reading.

Gautam Mitra

Rochester, New York, U.S.A.

### Scotland revisited

Craig, G. Y. (editor) 1991. *The Geology of Scotland* (3rd edn). Published by the Geological Society of London, U.K. Price £65 (hardback; ISBN 0 903317 63 X); £29 (paperback; ISBN 0 903317 64 8).

The *Geology of Scotland* was first published in 1965, a second edition followed 18 years later in 1983 and now we have a third edition. So why should all those who purchased the second edition want to spend another £29 on the new edition? Has the last 8 years seen significant developments in our understanding and interpretation of Scottish Geology?

At first sight the third edition seems only slightly different; the cover is a slightly darker shade of blue and the cover illustration has changed, with the Bass Rock replacing the more readily recognizable Suilven. However, inside the cover there are 120 more pages and the majority of the text has been fully revised and largely rewritten by a total of 19 contributors. The resulting volume is a detailed account of one of the most studied areas of the world, suitable for undergraduates, ‘expert’ amateurs and as stated in the publisher’s summary, is ‘an indispensable reference work for geologists worldwide’.

The contents pages are less informative than those of the earlier volumes, but the layout is very similar. After an introductory chapter by A. L. Harris, summarizing the growth and structure of Scotland, and highlighting some of the controversies and recent developments in our understanding of particularly the Caledonides, the chapters follow in chronological sequence. There is a new chapter on the Lewisian by R. G. Park. The Torridonian has most deservedly been separated from the Moine with new chapters by A. D. Stewart, and A. L. Harris and M. R. W. Johnson, respectively. The Dalradian is described by M. R. W. Johnson and followed by two chapters on the Lower Palaeozoic by E. K. Walton and G. J. H. Oliver. P. E. Brown’s chapter on Caledonian and Earlier Magmatism has nearly doubled in length. There then follow chapters on the Old Red Sandstone (W. Mykura), the Carboniferous and Carboniferous–Permian Igneous Rocks (E. H. Francis), the Permian and Triassic (J. P. B. Lovell), the Jurassic, Cretaceous and Tertiary (A. Hallam), Tertiary Igneous Activity (H. Emeleus), the Quaternary (G. S. Boulton, J. D. Peacock and D. Sutherland) and finally Economic Geology (R. Beveridge, S. Brown, M. Gallagher, and J. Merritt). There is a reference list at the end of each chapter, making the text an excellent source book. The index is also very useful.

My only criticisms must be directed at the illustrations and diagrams. Many of the photographs are duplicates of those in the second edition and have been poorly reproduced, some are so dark that the geology